NON-PUBLIC?: N
ACCESSION #: 9212030486
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Palisades Plant PAGE: 1 OF 05

DOCKET NUMBER: 05000255

TITLE: AUTOMATIC REACTOR TRIP ON LOSS OF LOAD RESULTING FROM UNSTABLE
VOLTAGE TO THE TURBINE CONTROL SYSTEM COMPUTERS
EVENT DATE: 10/30/92 LER #: 92-039-00 REPORT DATE: 11/25/92

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On October 30, 1992 at 0700 hours, the plant was operating at 100% power. As a result of a turbine generator trip the reactor automatically tripped on a loss of load signal. The turbine generator trip was initiated by coincident shutdown of the primary and backup computers in the turbine generator digital electrohydraulic (DEH) control system. Plant response to the event was good, with no safety significant deviations or anomalies noted.

By design the DEH computers were being supplied from a single uninterruptable power supply (UPS). The cause of this event was a failure of the UPS to maintain proper voltage at the input to the DEH power supplies. Voltage variations at the UPS output (i.e., the DEH input power supply) could not be handled by the DEH system and all four

DEH computers automatically went to their fail safe condition tripping the turbine generator.

Corrective action for this event included adding redundancy to the computer power circuits; adjusting voltage and installing new cables on the existing power source, installing two new voltage regulating transformers in the back-up power source; installing new power supplies in all four DEH data processing computers, and adding alarms to the DEH control room console.

END OF ABSTRACT

EVENT DESCRIPTION

On October 30, 1992, at approximately 0700 hours, the plant was operating at 100% power with all systems in normal full power alignment, when the reactor automatically tripped on a loss of load signal. The loss of load signal was a result of an unstable voltage (power supply) to the turbine digital electrohydraulic (DEH) control system TG;CPU! computers. Subsequently all four of the DEH data processing units shut down, causing a turbine trip signal which enabled the associated Reactor Protective System loss of load trip. Low steam generator levels in both generators initiated an AFWAS and the start of one auxiliary feedwater pump BA;P! which restored the steam generator water levels. Operations entered Emergency Operating Procedure (EOP) 1, "Post Trip Actions" and later EOP 2, "Trip Recovery" to stabilize the plant in hot shutdown. The trip recovery actions included emergency boration that was due to the failure of Bus 1A to transfer to start-up power and the resulting loss of 2 of the 4 operating primary coolant pumps.

A post trip review was completed shortly after the event. The following are highlights from the post trip review report.

The 4160 VAC non-safety related Bus 1A supplying two of the four primary coolant pumps, failed to transfer to start-up power from station power, resulting in the loss of two primary coolant pumps.

The secondary rod position for control rod drive number 16 remained at its previous indication of about 73 inches following the trip. The primary indication showed that the control rod had dropped to the bottom of the core.

Two of the four plant control room event recorders (3 and 4), did not activate on the trip.

This event is reportable in accordance with 10 CFR 50.73 (a)(2)(iv) as an event that resulted in the automatic actuation of the reactor protective system.

CAUSE OF THE EVENT

The cause of this event was a failure of the uninterruptable power supply (UPS) to maintain proper voltage at the input to the DEH power supplies. Voltage variations at the UPS output (i.e. the DEH power supply input) could not be handled by the DEH system and the DEH computers automatically went to their fail safe condition. All four DEH computers shut down, tripping the turbine generator. This turbine generator trip resulted in the loss of load trip of the reactor.

ANALYSIS OF THE EVENT

The plant had previously tripped on July 1 and July 24, 1992, on loss of load signals generated from a loss of power to the DEH system. After the July 1, 1992 event, post trip testing had duplicated the plant trip by what was determined to be loose computer

connecting cables. Following the July 24, 1992 plant trip, it had been determined that input voltage fluctuations to the DEH computors had been the probable cause for both the July 1, 1992 and the July 24, 1992 plant trips. The July 24, 1992 plant trip occurred coincident with the performance of a plant test which calls for the plant sequencer to simultaneously start a number of safety injection system loads. The starting of this equipment resulted in a momentary system voltage drop. This low voltage input was interpreted by the DEH as a loss of primary power. The DEH then attempted to switch to its secondary power source. The DEH's power supply voltage dropped to below approximately 4.5 volts while it was seeking a stable power source from its secondary power supply, and when the voltage went lower than 4.5 VAC, the DEH shut itself down to prevent damage. With the DEH not in operation a turbine trip was initiated. To correct this deficiency an uninterruptable power supply with an extended battery capacity was added to the system to filter any erratic incoming voltage to the DEH data processing units power supplies.

On October 30, 1992, by design, the DEH computers were being supplied from a single uninterruptable power supply. Because of the low and unstable input voltage condition, the UPS switched to a bypass condition where it was no longer trying to condition the incoming voltage. As a result of this switching, the low and fluctuating voltage was now fed

directly to the DEH computer DC power supplies. We estimate that the UPS had been powering the DEH at approximately 132 VAC. When the UPS was bypassed the unfiltered line voltage now powering the DEH DC power supplies was estimated to be approximately 108 VAC directly from the plant distribution panel. The DEH power supplies could not withstand this approximate 24 VAC transient in its power feed and since the UPS was the primary power source to the two controlling and the two standby computers, all four computers shut down and the turbine trip signal was initiated.

Subsequent investigation has shown that the UPS was designed to switch to its battery back-up at an input voltage of approximately 176 VAC. The voltage supplied to the UPS was determined to be, on average, approximately 182 VAC versus a normal input voltage of 208 VAC plus or minus 10%. It is estimated that the voltage to the UPS varied from a low level of 176 VAC to a highest level of 187 VAC preceding the trip. It is believed that this low and varying voltage condition for extended periods of time led to the UPS inverter shutting down its rectifier and placing the UPS in the bypass mode.

The 4160 VAC non-safety related Bus 1A supplying two of the four primary coolant pumps failed to transfer to start-up power from station power, resulting in the loss of two primary coolant pumps. This start-up power breaker had been replaced with a spare following a similar failure to transfer during the July 1, 1992 plant trip. Investigation of the July 1 failure to transfer found that the breaker cubicle interlock was not properly aligned. Corrective actions were taken and the breaker operated successfully during three subsequent plant trips prior to the October 30, 1992 plant trip.

During diagnostic testing following the October 30 plant trip, using both the spare installed breaker and the breaker that was removed in July, we were able to recreate the breaker failure to close. Review of a video tape of the breaker in operation showed that the cubicle interlock foot pedal bounces during breaker operation. The purpose of this interlock is to ensure that the breaker is tripped prior to moving the breaker within the cubicle or withdrawing the breaker from the cubicle. The bouncing of the foot pedal allows it to strike the trip lever and trip the breaker. Visual inspection also showed that the metal floor of the breaker cubicle has an approximate three-eights inch bow. This flex in the floor apparently amplifies the interlock pedal bounce since installation of temporary shims allowed successful testing of the breaker. A temporary modification was installed to pin the interlock foot pedal to prevent inadvertent operation. Operation of the breaker is not affected, but the

pin must be removed before the breaker can be withdrawn from the cubicle.

A blown fuse was found in the common DC supply to control room event recorders 3 and 4. The fuse was replaced. Work order history has shown that this fuse has a history of blowing without finding a root cause. Replacement fuses with visual indication of blown condition were installed and they will be checked frequently to assure that the event recorders remain in service until a resolution to the fuse blowing is found.

During initial troub
eshooting to investigate why the secondary rod
position for control rod 16 indicated 73 inches when the rod was at the bottom of the core, the relay for the secondary rod position was tapped and the indication returned to its proper reading. The secondary position indication problems are being tracked by engineering as a long range operations concern item and therefore are being addressed on a programmatic basis.

While a reactor trip on loss of load is a challenge to the plant safety systems because of the plant trip, all plant safety systems performed as designed and no significant safety deviations or anomalies were noted.

CORRECTIVE ACTION

The existing DEH DC power supplies were changed to a power supply which has improved switching and input voltage tolerance.

The AC power supply to the back-up DEH computers was provided with power from a source independent of the UPS. This provides a degree of redundancy for the primary and backup computers.

Taps were changed on the transformer supplying power to the UPS to restore the voltage to a nominal 208 VAC from the previous 198 VAC. Further, additional electrical cable was run between the power panel and the UPS to reduce the voltage drop to less than 3% of nominal.

Voltage regulating transformers were installed to the DEH power supply inputs not supplied by the UPS, to help to condition the input voltage and to reduce the risk of unregulated voltage reaching the computers.

Alarms "UPS On Battery", and "UPS On Bypass", were added to the DEH system to provide the control room operators with an early warning of potential UPS problems.

Temporary voltage wave-form disturbance analyzers were installed on the DEH and UPS systems to monitor voltage conditions during system operation for the remainder of this operating cycle.

All of the above mentioned enhancements were successfully tested and proven to have significantly improved the tolerance of the DEH system to known or, expected voltage transients.

In addition to the temporary modification that was installed to pin the trip lever of the start-up power breaker to prevent inadvertent operation, the following longer term actions are planned as part of our corrective action process:

o Disassemble and inspect the spare 4160 volt breaker to assure that no other problems exist with it.
o Evaluate the replacement of existing springs, of all 2400/4160 volt breaker foot petals, with stronger springs to prevent or reduce pedal bounce during a close operation.
o Walk-down all 2400/4160 VAC breaker cubicles and inspect for warped or bowed floors and evaluate methods to reduce cubicle "floor bounce" during breaker operation.
o Review work order history files for evidence of any other medium voltage breaker malfunctions that may need to be investigated.

ADDITIONAL INFORMATION

Related recent plant trips have been reported in Licensee Event Reports 92-034 and 92-035.

Figure "Licensing Correspondence\Commitment Tracking Record Summary" omitted.

Consumers
Power G B Slade
General Manager

Palisades Nuclear Plant: 27780 Blue Star Memorial Highway,

Covert, MI 49043

November 25, 1992

Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT -
LICENSEE EVENT REPORT 92-039 - AUTOMATIC REACTOR TRIP ON LOSS OF LOAD
RESULTING FROM UNSTABLE VOLTAGE TO THE TURBINE CONTROL SYSTEM COMPUTERS

Licensee Event Report (LER) 92-039 is attached. This event is reportable in accordance with 10 CFR 50.73(a)(2)(iv) as an event that resulted in the automatic actuation of the reactor protective system.

Gerald B Slade
General Manager

CC Administrator, Region III, USNRC
NRC Resident Inspector - Palisades

Attachment

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